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TITLE OF THE INVENTION

A DEVICE FOR BINDING MOLECULES, MOLECULAR GROUPS,
MOLECULAR PARTS AND/OR CELLS

CROSS-REFERENCE TO RELATED APPLICATIONS

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This application claims the benefit of German Patent Application No.
19932958.3, filed on July 14, 1999.

BACKGROUND OF THE INVENTION

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The present invention relates to a device for binding molecules, molecular
groups, molecular parts and/or cells contained in a liquid to target structures, as
well as to a method for binding molecules, molecular groups, molecular parts
and/or cells contained in a liquid to target structures.

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The only method known so far for binding molecules, molecular groups,
molecular parts and/or cells contained in a liquid to target structures is the one
according to "Stamper and Woodruff (1976) *J. Exp. Med.* 144, 828-833". This

method comprises the fixing of target structures to a surface and subsequently rehydrating them. Then, the target structures are coated with 100 to 200 µl of the liquid containing the molecules, groups of molecules, parts of molecules and/or cells. Incubation (e.g.: 30 min, 7°C) thereof on a shaker or rotating table is
5 followed by a rinsing step which will remove any non-binding matter.

One major disadvantage of this method is the fact that it is performed manually. Moreover, motion devices are used for obtaining the binding equilibrium which only poorly simulate the conditions prevailing in certain
10 natural systems. Another shortcoming is that the rinsing step may destroy the often weak adherence of ingredients of the liquid to the target structures. Yet another disadvantage of this method is that it is not capable of stopping metabolic processes.

15 It is therefore the object of the present invention to provide a device and a method for simulating the short-term interactions occurring between molecules, molecular groups, molecular parts and/or cells in a liquid, on the one hand, and the target structures, on the other, at the same time allowing most of the metabolic processes to be stopped at any time.

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This object is accomplished by a device and a method having the features of the independent claims.

Advantageous embodiments are described in the subclaims.

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A device of the invention for binding molecules, molecular groups, molecular parts and/or cells contained in a liquid to target structures comprises at least one object holder with at least one target structure firmly held therein which is in contact with at least one duct made of at least one material, said duct
30 including, at its one aperture, a liquid inlet and, at its other aperture, a liquid

outlet, as well as at least one object holder thermostat used for cooling the respective object holder.

This is based on the inventive idea that flowing a liquid containing
5 molecules, molecular groups, molecular parts and/or cells through a duct which is
in contact with a target structure will cause said molecules, molecular groups,
molecular parts and/or cells to bind to said target structure. Any non-binding
matter can be removed via the second duct aperture. At the same time, the
temperature of the object holder will be controlled by the object holder
10 thermostat. Owing to the flowing motion, passing the liquid containing
molecules, molecular groups, molecular parts and/or cells over the target structure
is a better way of simulating natural systems with short-term interactions than by
means of a prior art shaker or a prior art rotating table. A particular advantage of
the invention is that it allows an interruption of metabolic processes at any time
15 by decreasing the temperature of the object holder by means of the object holder
thermostat. In doing so, the temperature of the object holder will be 2-10°C, in
particular 4°C.

In an advantageous embodiment of the invention, the duct is formed by the
20 object holder and paraffin-like sheet material. This allows the duct to widen, if
necessary, preventing excessive pressure build-up within said duct.

In yet another advantageous embodiment of the invention, the discharged
liquid will be collected in a vessel, thus preventing a loss of liquid which has
25 already passed the duct, which liquid may be difficult and/or expensive to
prepare.

In another advantageous embodiment of the invention, the temperature of
the vessel will be cooled by a vessel thermostat, thus preventing any metabolic
30 processes from occurring within said vessel and allowing the liquid or its
ingredients to be used again.

A method of the invention for binding molecules, molecular groups, molecular parts and/or cells contained in a liquid to target structures comprises the following steps: (a) passing liquid through a duct and over an object holder carrying a target structure firmly held therein, (b) removing any non-binding matter via a second duct aperture and collecting such matter in a vessel, (c) cooling said object holder by means of an object holder thermostat, and (d) fixing the molecules, molecular groups, molecular parts and/or cells adhering to the object holder.

In yet another advantageous embodiment of the invention, the device is used in an automated method for determining molecular classes, molecular groups, molecular parts in a solid or liquid object according to U.S. patent application serial number 09/353,942, the entire specification of which is incorporated herein by this reference. This will allow identification and characterization of the binding partners. It will be possible at the same time to identify and characterize the molecular classes, molecular groups and/or molecular parts required for the binding process. Such application will be advantageous in numerous areas of chemistry, biology, biochemistry and especially medicine. This will not only open up new possible ways of diagnosing, but will also provide a new test system for therapeutic approaches on a molecular level.

BRIEF DESCRIPTION OF THE DRAWINGS

Further details, features and advantages of the invention will ensue from the description, which follows, of an embodiment illustrated in the drawings, of which:

Figure 1a is a top view of an object holder of the device of the invention;

Figure 1b is a cross-sectional view of the object holder of Figure 1a;

Figure 2a is a schematic lateral view of the device of the invention; and

Figure 2b is a detailed view of an element of the device of the invention.

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DETAILED DESCRIPTION OF THE INVENTION

Figure 1a is a top view of an object holder 10 of the device for binding molecules, molecular groups, molecular parts and/or cells, whereas **Figure 1b** is a cross-sectional view of the object holder 10.

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It can be seen that a target structure 12 has been detachably mounted on said object holder 10 and contacts a duct 14 defined by said object holder 10, two paraffin-sheet strips 20 and a continuous paraffin-sheet layer 22. Two aluminum rails 24 are mounted on said paraffin-sheet layer 22 whose surface areas are similar to that of said paraffin-sheet strips 20 underneath them. Furthermore, it may be gathered from this figure that duct 14 has first and second duct apertures 16, 18 for inlet and outlet, resp., of liquid 62. Liquid 62 may be discharged by means of a plunger mechanism 58, a pump (not shown), or under the influence of gravity and by means of a pump (not shown), or under the influence of gravity alone.

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Figure 2a is a schematic lateral view of the device for binding molecules, molecular groups, molecular parts and/or cells, with said object holder 10, including paraffin-sheet strips 20, paraffin-sheet layer 22, aluminum rails 24, a hollow needle 60 and said liquid 62, being additionally shown in detail in **Figure 2b**.

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These illustrations show that – besides the elements mentioned above – the device includes an object holder thermostat 26 comprising a cooling plate 28, made of aluminum, a first Peltier element 30, a first cooling element 32 and a first fan 34. Said device is mounted on a post 52 with clamping joint 54 in such a way

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that the angle between the mounted object holder 10 and a basic plate 64 is approx. 20-70°. Object holder 10 is firmly pressed onto object holder thermostat 26 by a pressure plate with a central aperture 36 which rests on aluminum rails 24. Sufficient pressure is ensured by way of springs 38.

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Liquid 62 is introduced into the first duct aperture 16 by means of a suture 58 detachably mounted by means of a suture support 56, and a hollow needle. Under the influence of gravity, liquid 62 will thus flow through duct 14 and contact target structure 12, allowing the desired and predetermined ingredients of liquid 62 to bind to target structure 12. Finally, liquid 62 will reach the second duct aperture 18, exit duct 14 and drip into a vessel 40 surrounded by a vessel thermostat 42. Said vessel thermostat 42 comprises a vessel support 44, made of copper, a second Peltier element 46, a second cooling element 48 and a second fan 50.

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Once all of said liquid 62 (approx. 1 ml) has passed through said duct 14, object holder thermostat 26 and vessel thermostat 42 will cool said vessel 40 and said object holder 10 down to 4°C so as to stop any metabolic activity.

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Liquid 62 may contain lymphocytes. Target structure 12 is a tissue section or a membrane coated with molecules or molecular combinations.

CLAIMS

What is claimed is:

- 5 1. A device for binding molecules, molecular groups, molecular parts
and/or cells contained in a liquid to target structures **wherein** said
device comprises at least one object holder with at least one target
structure firmly held therein which contacts at least one duct made of
at least one material, said duct including a liquid inlet at a first aperture
10 thereof, and a liquid outlet at a second aperture thereof, as well as at
least one object holder thermostat used for cooling said object holder.
2. The device of claim 1 **wherein** said duct is formed by said object
holder and paraffin-like sheet material.
- 15 3. The device as claimed in claim 1 **wherein** said liquid is introduced by
means of a plunger mechanism, a pump or under the influence of
gravity.
- 20 4. The device as claimed in claim 1 **wherein** said liquid can be
discharged by means of a pump or under the influence of gravity.
5. The device as claimed in claim 1 **wherein** the temperature of said
object holder can be cooled down to 2-10°C by means of the object
25 holder thermostat.
6. The device as claimed in claim 1 **wherein** the object holder thermostat
includes a first Peltier element.
- 30 7. The device as claimed in claim 1 **wherein** the discharged liquid will be
collected in a vessel.

8. The device as claimed in claim 7 **wherein** the temperature of said vessel will be cooled down by means of a vessel thermostat.
- 5 9. The device as claimed in claim 8 **wherein** a vessel thermostat allows the temperature of said vessel to be cooled down to 2-10°C.
10. The device as claimed in claim 7 **wherein** said vessel thermostat includes a second Peltier element.
- 10 11. The device as claimed in claim 8 **wherein** said vessel thermostat includes a second Peltier element.
12. The device as claimed in claim 1 **wherein** said liquid contains lymphocytes.
- 15 13. The device as claimed in claim 1 **wherein** said target structure is a tissue section or a membrane coated with molecules or molecular combinations.
- 20 14. A method for binding molecules, molecular groups, molecular parts and/or cells contained in a liquid to target structures **wherein** said method comprises the following steps:
- 25 a. passing liquid through a duct and over an object holder with a target structure firmly held therein,
- b. removing any non-binding matter via a second aperture of said duct and collecting said matter in a vessel,
- c. cooling said object holder by means of an object holder thermostat, and
- 30 d. fixing the molecules, molecular groups, molecular parts and/or cells binding to said object holder.

- 5 15. Use of the device as claimed in one of the preceding claims in an automated method for determining molecular classes, molecular groups, molecular parts in a solid or liquid object according to U.S. application serial number 09/353,942.

ABSTRACT OF THE DISCLOSURE

5 The present invention relates to a device for binding
molecules, molecular groups, molecular parts and/or cells
contained in a liquid to target structures, the device having at least
one object holder with at least one target structure firmly held
therein and which contacts at least one duct made of at least one
material. One aperture of the duct is a liquid inlet aperture, and a
second aperture is a liquid outlet aperture. At least one object
10 holder thermostat is used for cooling the object holder.

The present invention relates to a device for binding
molecules, molecular groups, molecular parts and/or cells
contained in a liquid to target structures, [said] the device having at
15 least one object holder with at least one target structure firmly held
therein and which contacts at least one duct made of at least one
material. [A] One aperture of [said] the duct is a liquid inlet
aperture, and a second aperture is a liquid outlet aperture. [with]
At least one object holder thermostat [which] is used for cooling
20 the object holder.

~~The present invention relates to a device for binding molecules, molecular~~
~~groups, molecular parts and/or cells contained in a liquid to target structures, said~~
~~device comprising at least one object holder with at least one target structure~~
25 ~~firmly held therein which contacts at least one duct made of at least one material.~~
~~A first aperture of said duct is a liquid inlet aperture, and a second aperture~~
~~thereof is a liquid outlet aperture, with at least one object holder thermostat~~
~~which is used for cooling the respective object holder also being provided.~~

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